INTERSTITIAL OPISTHOBRANCH GASTROPODS FROM THE WEST EUROPEAN COASTS: REMARKS ABOUT TERATOLOGICAL SPECIMENS

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ABSTRACT

Numerous large dredge and grab samples of sand obtained between 1970 and 1983 from sublittoral sandy bottoms along west European shores (Irish Sea, North Sea, Skagerrak and Western Mediterranean) made possible the collection of 15 species of interstitial opisthobranch gastropods. Among this material only two species were detected with evident abnormal features: *Embletonia pulchra* Alder and Hancock and *Hedylopsis spiculifera* (Kowalevsky). In *E. pulchra* these abnormalities involved rhinophores (lacking or of reduced size); oral veil (absent or of abnormal shape); cerata (either absent, or of abnormal shape or arrangement); rear part of the foot (slender with regard to axis of the body); and body size (reduced with regard to number of cerata). In *H. spiculifera*, abnormal dorsal tegumental verrucosities were present on the visceral hump. These abnormal features are apparently not lethal but are chronic and very rare (< 1/1000). Therefore, they can hardly be linked to any alteration of the natural medium (pollution of the sublittoral sands and gravels where these interstitial opisthobranchs live). They can rather be related to an accidental injury inflicted upon individuals during their larval stages or during their growth, and subsequently imperfectly or not readjusted.

Teratological specimens are common among the molluscs, but their interpretation remains difficult and certainly only a few of them have been detected as abnormal. Fischer (1970) described an aberrant pulmonate gastropod, *Cryptomphalus (Helix) aspera* (Müller), with an abnormal shell, from southern California. A sinistral aberrant of the same species was reported by Basinger (1931). Among the prosobranch gastropods, Sykes (1903) described a monstrosity of *Rissoa parva* Da Costa, in which the later whorls of the shell were smooth, while Gaudio (1985) recorded an anomalous individual of *Astrea rugosa* (Linné) with abnormally sculptured shell. In the cephalopod molluscs, another abnormality is recorded by Smith (1903) in a specimen of *Argonauta argo* L. with thickened shell columella. Among the benthic opisthobranchs, Tardy (1970) observed a great number of teratological individuals of *Aeolidiella alderi* (Cocks) (absence of cerata at rear part of the body) in the aquarium, supplemented by other similar abnormalities recorded from the natural habitat, in *A. sanguinea* (Norman). To date, no such abnormalities have been recorded among the interstitial opisthobranchs. However, during a survey along the West-European shores, collection of numerous individuals of various interstitial opisthobranch species (Poizat, 1978) made it possible to record several forms of abnormalities.

METHODS

A simple but efficient extraction procedure (see Poizat, 1975) made it possible to treat large volumes of sublittoral sediments, dredged or grabbed along West-European coasts: Northern Ireland (Poizat, 1979); Sweden, Bohüslan shores (Poizat, 1980); Yorkshire, U. K. (Poizat, 1981); and Western Mediterranean, France (Poizat, 1978). Subsequently several thousands of interstitial opisthobranchs belonging to 15 species were recovered (Poizat, 1985).

RESULTS

Only two species exhibited abnormalities: *Embletonia pulchra* Alder and Hancock, 1844 (Nudibranchia, Tergipedidae) with serious and numerous abnormal features, resulting sometimes in aberrant specimens; *Hedylopsis spiculifera* (Kowalevsky) (Acochlidiacea) with very few abnormal features. Examples of two additional species, *Pontohedyle milaschewitschii* (Kowalevsky) and *Unela glandulifera* (Kowalevsky), had transient abnormalities restricted to juvenile specimens. Different parts of the body (i.e. rhinophores, oral veil, cerata, visceral hump, foot) were more or less affected by various abnormalities (i.e. absence,

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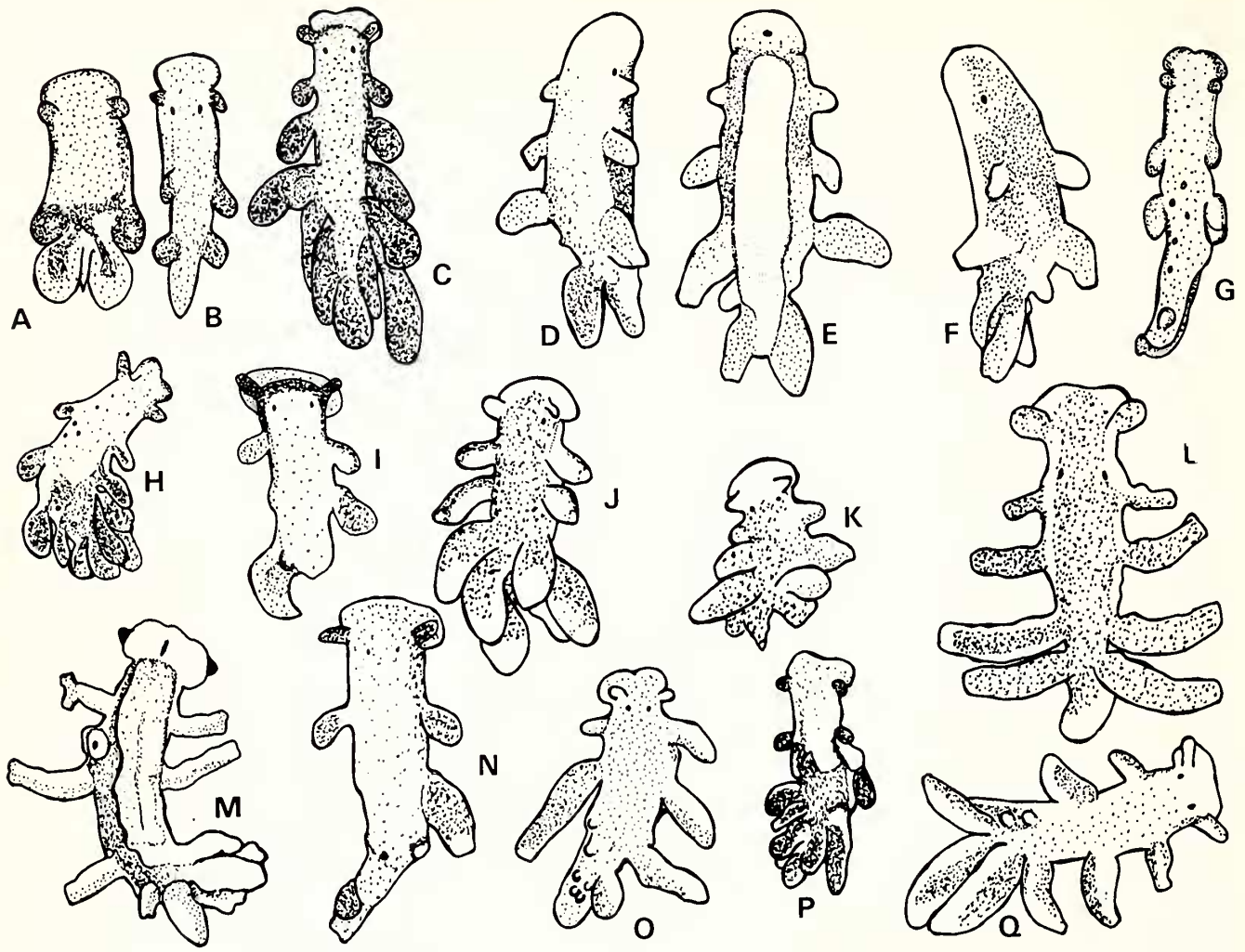

Fig. 1. *Embletonia pulchra* (after photos of living or preserved specimens). **A.** Dorsal view of a juvenile normal living specimen from Western Sweden, 0.4 mm long, with two pairs of cerata, round oral veil, short cylindrical rhinophores. **B.** Dorsal view of a juvenile normal specimen from Western Sweden, 0.8 mm long. **C.** Dorsal view of an adult normal specimen from Western Sweden, 3.0 mm long, with long cylindrical rhinophores, bilobed oral veil and 13 cerata. **D-F.** Right, ventral and left view of an abnormal 1.75 mm specimen from Marseilles, without rhinophores, without oral veil and only five cerata on the right side, four on the left side of the dorsum. **G.** Dorsal view of an abnormal 1.5 mm long adult specimen, from Northern Ireland, with only two pairs of cerata and one odd bud of cerata on the tail. **H.** Dorsal view of a 2 mm long specimen from Sweden, with oral veil of abnormal shape. **I.** Dorsal view of an abnormal 0.6 mm specimen from Northern Ireland, with slender tail. **J.** Dorsal view of an abnormal 1.8 mm specimen from Marseilles, with round oral veil and inflated cerata. **K.** Dorsal view of a small abnormal specimen (1 mm) from Marseilles, with round oral veil and cerata very close to each other. **L.** Dorsal view of an abnormal 1.6 mm specimen from Marseilles, with abnormal arrangement of cerata. **M.** Ventral view of an abnormal 1.6 mm specimen from Marseilles, with bifurcate cerata (genital opening visible between the two first right cerata). **N.** Dorsal view of an abnormal 1.5 mm specimen from Northern Ireland, with round oral veil, low number of cerata and slender tail. **O.** Dorsal view of a 1.6 mm abnormal specimen from Marseilles with buds of cerata on left rear side of the body. **P.** Dorsal view of a 1.7 mm specimen from Sweden, with abnormal arrangement of cerata. **Q.** Dorsal view of an abnormal 1.5 mm specimen from Marseilles, with very long inflated cerata on the right side of the dorsum, buds of cerata on the left side.

aberrant shape, reduced size, etc.) (Table 1). Sometimes two and up to three of these abnormalities coexisted on the same individual, resulting in a very aberrant animal that, however, apparently maintained normal activity patterns.

Embletonia pulchra (Fig. 1). Based on about 1300 European specimens examined, this species appeared most subject to abnormalities. Up to three aberrant features can coexist on the same specimen (Fig. 1K): abnormal round shape of oral veil on adult individual (instead of bilobed), reduced body length and correlatively, cerata very close to each other. Comparing juvenile (body length < 1.5 mm) and adult individuals (Fig. 1A-C) suggests that a round oral veil and small body size and low number of cerata are juvenile features, while conversely, high number of cerata (up to seven on each side

Table 1. Teratological features observed in interstitial opisthobranchs.

Character	Abnormality	Species	Locality	Figures
Rhinophores	1. Lacking (one or both)	*Embletonia pulchra*	Marseilles	1D, F
	2. Reduced size (one or both)	*E. pulchra*	Marseilles	
Oral veil	3. Lacking	*E. pulchra*	Marseilles, Sweden	1D-F
	4. Abnormal shape (round instead of bilobed)	*E. pulchra*	Marseilles	1I, K
Cerata	5. Lacking	*E. pulchra*	Northern Ireland	1G, I
	6. Abnormal shape (bifurcate or inflated)	*E. pulchra*	Marseilles	1M
	7. Abnormal arrangement (asymetric or very close to each other)	*E. pulchra*	Sweden	1P
	8. Abnormal reduced size (buds)	*E. pulchra*	Marseilles	1O, Q
Foot	9. Slender axis of rear part	*E. pulchra*	Northern Ireland	1I, N
Body size	10. Abnormally reduced	*E. pulchra*	Marseilles	1K
	11. Visceral hump reduced in juvenile only	*Pontohedyle milaschewitschii* *Unela glandulifera* *Hedylopsis spiculifera*	Marseilles	
Tegument	12. Abnormal verrucosities on visceral	*H. spiculifera*	Marseilles	2B, C

of the body) correlate with long body size, and bilobed oral veil as adult. Coexistence of some of these juvenile and adult features on the same individual results in a monstrosity (Fig. 1K). Complete lack of oral veil and of rhinophores together with a reduced number of cerata in spite of normal adult size (Fig. 1D-F) has been recorded on the same individual, but this kind of abnormality was rare (< 1/1000). Bifurcate shape of cerata (Fig. 1M) is also a rare aberrant feature. More frequent is the low number of cerata with regard to the body size (Fig. 1G), coexisting sometimes with a slender axis of the rear part of the foot (Fig. 1I, N). Very asymmetric disposition of cerata (Fig. 1G, O-Q) is not uncommon. Still more frequent (> 6/1000) are individuals exhibiting buds of cerata (juvenile features ?) on both or either side of the body (Fig. 1O, Q) in spite of a normal adult body size (> 1.5 mm). For example, a 2.8 mm specimen of *E. pulchra* had seven buds on the left part of the body and seven normal cerata on the right; another specimen (1.62 mm) had five buds of cerata on both sides of the dorsum. Round oral veil (instead of bilobed in normal adult specimens) is found in up to 8/1000 of the European specimens examined and it is frequently associated with atrophy or lack of either or both rhinophores.

Hedylopsis spiculifera (Fig. 2). Among the approximately 2500 individuals collected along the European shores (Fig. 2A), only three specimens from the Gulf of Marseilles can be considered as slightly aberrant: a 1.08 mm (Fig. 2B) and a 1.86 mm individual exhibited one curious verrucosity protruding ahead at both dorsal front sides of the visceral hump. Another individual (1.30 mm) possessed three medio-dorsal verrucosities protruding on its visceral hump (Fig. 2C).

Pontohedyle milaschewitschii and *Unela glandulifera*. Out of approximately 1500 individuals of *P. milaschwitschii* examined and measured in a relaxed fixed state, five very slightly abnormal juvenile specimens (body size < 1.5 mm) were detected by their relatively reduced visceral hump. In normal fixed juvenile specimens, the visceral hump generally corresponds to about 63% of the total length of the animal, while in fixed adult specimens, it corresponds to about 77%.

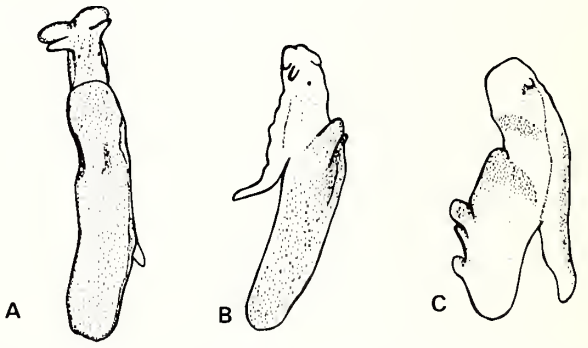

Fig. 2. *Hedylopsis spiculifera* (after photos of living and preserved specimens). **A.** Dorsal view of a normal 1.5 mm adult specimen from Marseilles. **B.** Left view of a 1.8 mm long abnormal specimen with two symetrical expansions at the front dorsal part of the visceral hump. **C.** Right side of a 1.3 mm long abnormal specimen with three odd verrucosities on the doral median line of the visceral hump.

In the most abnormal juvenile specimens collected in the Gulf of Marseilles, with a 0.68 mm body length, the visceral hump (0.30 mm) corresponded to only 44% of the total length. Since such a shortened visceral hump has not been recorded in adult specimens, it must be interpreted as a temporary abnormality that would subsequently readjust during growth. Similar temporary and more unusual abnormalities were observed with *Unela glandulifera* and also with *Hedylopsis spiculifera* corresponding to a very slight temporary negative allometry.

DISCUSSION

The teratological features described here are extremely unusual and therefore cannot be related to pollution. They are not lethal since the aberrant animals remained normally active several days after they were collected and had the same behaviour as normal ones, apart from the fact that no reproductive activity was exhibited by normal nor abnormal

specimens. In Tardy's (1970) observations the teratological features recorded for *Aeolidiella alderi* were also not lethal, the more so as the adults descending from aberrant parents were normal and able to reproduce.

Most of the teratological features recorded on interstitial opisthobranchs in their natural habitat are probably chronic, especially because they proved to concern mainly adult specimens, the growth of which has stopped and therefore without possibility of correction. However, two categories of abnormalities can be distinguished and explained differently: the lack of one or several body parts; malformations of existing structures. For example, total lack of oral veil and/or rhinophores in *Embletonia pulchra*, and also total or partial lack of cerata on adults can be due to a serious and early perturbation during larval life definitely interrupting the normal development of the injured parts of the embryos. Precisely, Tardy (1970) interprets the teratological specimens of *Aeolidiella alderi* as resulting from such an accidental perturbation during early larval stages. On the contrary, malformations such as slender axis of the tail, buds of cerata or rhinophores, bifurcate cerata on adult *Embletonia pulchra* and verrucosities on the visceral hump of *Hedylopsis spiculifera,* probably result from a slight injury inflicted upon the individuals after their larval period, during their growth at a time when readjustment is still possible. This regeneration however can occur in an abnormal way. The monstrosity recorded by Sykes (1903) in *Rissoa parva* probably results from such a slight injury to the animal during its post larval growth, leading to an aberrant readjustment.

In general, it appears that either abnormal or normal regeneration remains possible provided the injury is not too serious. For example, in Tardy's experiments (1970) the removed cerata regenerate (on adult specimens) only if the gut diverticulum has not been excised. Other experiments (see Poizat, 1971; Poizat *et al.,* 1981) concerning adult specimens of interstitial opisthobranchs, such as microsurgical removal of the rhinopores of *Hedylopsis spiculifera*, or chemical treatment with mercuric chloride of *Pontohedyle milaschewitschii* lead to the same conclusions. In *P. milaschewitschii,* regeneration of the oral veil remained possible only if the concentration of mercuric chloride does not exceed 0.08 g/l sea water during 20 hr (sublethal dose) and if the animals were returned to normal sea water. In such condition, the tegument of the animals that represents their respiratory organ had not been deeply injured and therefore, readjustment was normal and complete. Microsurgical removal of the rhinophores of adult *H. spiculifera* was also followed by a total and normal regeneration in about 26 days (Poizat, 1971), because the excision was restricted to a very small area where morphallaxis phenomena seemed to occur.

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